AMENDMENTS TO THE SPECIFICATION:

Page 1, please add the following new paragraphs before paragraph [0001]:

[0000.2] CROSS-REFERENCE TO RELATED APPLICATIONS

[0000.4] This application is a 35 USC 371 application of PCT/DE 2004/000569 filed on March 19, 2004.

[0000.6] BACKGROUND OF THE INVENTION

Please replace paragraph [0001] with the following amended paragraph:

[0001] ~~Prior Art~~ **Field of the Invention**

Please replace paragraph [0002] with the following amended paragraph:

[0002] The invention relates to an **improved** actuator unit comprising a piezoelectric actuator. ~~Such actuator units are used, among other ways, in fuel injection systems and particularly in fuel injection valves, since the switching times of such actuator units are very fast. The short switching times allow more-exact dimensioning of the injected fuel quantity and enable improved shaping of the course of the injection over time. The overall term "fuel injection valve" is understood in conjunction with the invention to mean all types of fuel injection valve, such as injectors for common rail injection systems or injection nozzles of conventional fuel injection systems. A fuel injection valve with a piezoelectric actuator is actuated by subjecting the piezoelectric actuator to an electrical voltage, and as a result the piezoelectric actuator, because of known physical effects of the piezoceramic, expands rapidly and lifts the valve closing member from a valve seat. The piezoelectric actuator has a certain mass, which is accelerated. If the voltage applied to the actuator is reduced, the actuator has the tendency to contract. Because of the mass inertia of the previously~~

~~accelerated mass of the actuator, the result, depending on the triggering speed, is tensile forces in the actuator, which cause damage to the piezoelectric actuator, especially cracks in the soldered connections between individual layers of the piezoelectric actuator. To avoid such damage, the procedure has changed to prestressing the piezoelectric actuator in the axial direction by means of a cylindrical hollow body embodied as a spring. One such arrangement is known, for instance from International Patent Disclosure WO 00/08353 (Siemens). This hollow body is bent from a flat metal sheet and is welded at the first seam thus created. The first seam extends parallel to the longitudinal axis of the hollow body.~~

Please add the following new paragraph after paragraph [0002]:

[0002.2] Description of the Prior Art

Please add the following new paragraph after paragraph [0002.2]:

[0002.4] Actuator units of the type with which this invention is concerned are used, among other ways, in fuel injection systems and particularly in fuel injection valves, since the switching times of such actuator units are very fast. The short switching times allow more-exact dimensioning of the injected fuel quantity and enable improved shaping of the course of the injection over time. The overall term "fuel injection valve" is understood in conjunction with the invention to mean all types of fuel injection valves, such as injectors for common rail injection systems or injection nozzles of conventional fuel injection systems. A fuel injection valve with a piezoelectric actuator is actuated by subjecting the piezoelectric actuator to an electrical voltage, and as a result the piezoelectric actuator, because of known physical effects of the piezoceramic, expands rapidly and lifts the valve closing member from a valve seat. The piezoelectric actuator has a certain mass, which is accelerated. If the voltage applied to

the actuator is reduced, the actuator has the tendency to contract. Because of the mass inertia of the previously accelerated mass of the actuator, the result, depending on the triggering speed, is tensile forces in the actuator, which cause damage to the piezoelectric actuator, especially cracks in the soldered connections between individual layers of the piezoelectric actuator. To avoid such damage, the procedure has changed to prestressing the piezoelectric actuator in the axial direction by means of a cylindrical hollow body embodied as a spring. One such arrangement is known, for instance from International Patent Disclosure WO 00/08353 (Siemens). This hollow body is bent from a flat metal sheet and is welded at the first seam thus created. The first seam extends parallel to the longitudinal axis of the hollow body.

Page 2, please replace paragraph [0004] with the following amended paragraph:

[0004] ~~Advantages of the Invention~~

SUMMARY AND ADVANTAGES OF THE INVENTION

Page 3, please replace paragraph [0008] with the following amended paragraph:

[0008] Because according to the invention a second seam located diametrically opposite the first seam is placed in the hollow body, the spring rate of the hollow body on the side diametrically opposite the first seam is also reduced. As a result, the prestressing force introduced into the piezoelectric actuator by the upper cover plate and the lower cover plate acts precisely in the direction of the longitudinal axis of the piezoelectric actuator. Such loads are highly favorable for the piezoelectric actuator, and hence the service life of the

actuator units equipped with a hollow body according to the ~~hollow body~~ **invention** can be increased markedly.

Page 4, please replace paragraph [0012] with the following amended paragraph:

[0012] If only a radial fixation of the hollow body is necessary, it can be done by means of an annular groove or a shoulder in the upper and/or lower cover plate, or in the adjusting disk and the coupler housing. This may be adequate, for instance whenever the hollow body is not stressed by tension but only by ~~pressure~~ **compression**. An especially advantageous feature of these variant embodiments is that the hollow body is centered relative to the piezoelectric actuator or the hydraulic coupler by the annular groove and the shoulder. This effect can be improved still further if the annular groove and shoulder are dimensioned such that they widen the hollow body slightly during assembly.

Page 6, please replace paragraph [0019] with the following amended paragraph:

[0019] The recesses in the hollow body may have the familiar **dumbbell or** bonelike shape and may extend transversely to a longitudinal axis of the hollow body. It is also advantageous if a plurality of recesses are located one behind the other in one plane; and that the plane forms a right angle with the longitudinal axis of the hollow body. It has also proved advantageous if there is an even number of recesses in one plane.

Page 7, please replace paragraph [0023] with the following amended paragraph:

[0023] However, the hollow body of the invention can also be used in actuator units in which the piezoelectric actuator is disposed outside the hollow body; and that the piezoelectric actuator is stressed for pressure by the prestressed hollow body. In that case, as a rule, the hollow body is stressed ~~by pressure~~ **in compression**.

Please delete paragraph [0025].

Page 8, please replace paragraph [0026] with the following amended paragraph:

[0026] ~~Drawings~~ **BRIEF DESCRIPTION OF THE DRAWINGS**

Please replace paragraph [0027] with the following amended paragraph:

[0027] ~~Shown are:~~ **Other features and advantages of the invention will become apparent from the detailed description contained herein below, taken in conjunction with the drawings, in which:**

Please replace paragraph [0028] with the following amended paragraph:

[0028] Fig. 1[[,]] **is an elevation view, in section, of** a first exemplary embodiment of an actuator unit of the invention;

Please replace paragraph [0029] with the following amended paragraph:

[0029] Fig. 2[[,]] **shows** a second exemplary embodiment of an actuator unit of the invention;

Please replace paragraph [0030] with the following amended paragraph:

[0030] Fig. 3[[,]] **shows** one example of a flat sheet[[, out of]] **from** which a hollow body is [[bent]] **formed by bending**;

Please replace paragraph [0031] with the following amended paragraph:

[0031] Fig. 4[[,]] **is** a first exemplary embodiment of a hollow body in a perspective view, with an even number of rows (in this case 16) in the longitudinal direction;

Please replace paragraph [0033] with the following amended paragraph:

[0033] Fig. 6, a second exemplary embodiment of a hollow body of the invention, seen obliquely from below**, with an odd number of rows (in this case, 17) of recesses in the longitudinal direction**;

Please replace paragraph [0034] with the following amended paragraph:

[0034] Fig. 7, a third exemplary embodiment of a hollow body of the invention, with an [[odd]] **even** number of rows (in this case, [[17]] **16**) of recesses in the longitudinal direction;

Page 9, please replace paragraph [0036] with the following amended paragraph:

[0036] Fig. 9, a further exemplary embodiment of an actuator unit of the invention in **both a** fragmentary longitudinal section and in a **transverse** sectional view;

Please replace paragraph [0039] with the following amended paragraph:

[0039] ~~Description of the Exemplary Embodiments~~

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Please replace paragraph [0040] with the following amended paragraph:

[0040] In Fig. 1, a first exemplary embodiment of an actuator unit of the invention is shown[[.]] [[The]] **in which** actuator unit comprises a piezoelectric actuator 1, which may be constructed of a plurality of individual piezoelectric elements (not shown) stacked one above the other. The piezoelectric actuator 1 is triggered via contact pins 2, which are disposed

along the actuator 1 and are electrically conductively connected to the actuator 1. By applying a voltage between the contact pins 2, a longitudinal expansion of the piezoelectric actuator 1 is generated, which is used for instance for controlling an injection valve in an internal combustion engine. The piezoelectric actuator 1 with the contact pins 2 is disposed in a hollow body 4 embodied as a tubular spring. The piezoelectric actuator 1 rests with each of its end faces on a respective cover plate 5 and 6; the upper cover plate 6 has ducts 61, through which the contact pins 2 extend. The upper and lower cover plates 5, 6 are each joined to the hollow body 4 in form- and/or force-locking fashion, preferably by welding. The weld seams in the upper and lower cover plates 5, 6 and in the hollow body 4 are not shown in Fig. 1. Alternatively, the connection between the hollow body and the two cover plates 5, 6 may for instance be done with the aid of crimping, in which the crimped-over upper and lower peripheral regions of the hollow body 4 each engage the cover plates 5, 6 from inside (not shown).

Page 10, please replace paragraph [0042] with the following amended paragraph:

[0042] The hollow body 4 is preferably made from spring steel. To enable establishing a desired spring rate for a given wall thickness "s", many **apertures or** recesses 7 are made in the hollow body 4. For the sake of simplicity, not all the recesses have been identified with reference numerals in Fig. 1. Since the many recesses 7 can be best produced by punching, the hollow body 4 is as a rule made from sheet metal. From this sheet, first a flat **blank or** sheet with the recesses 7 [[is]] punched out **is formed**. Next, the flat sheet is bent, until it has a circular cross section, for instance, or a cross section in the form of a regular polygon.

Where the two ends of the bent flat sheet meet one another, a first seam (not shown in Fig. 1) is created.

Page 11, please replace paragraph [0047] with the following amended paragraph:

[0047] With its valve piston 83, the hydraulic coupler 81 actuates the control valve [[87]] 77, while the booster piston 85 rests with a protrusion 89 on the piezoelectric actuator 79. Via a hollow body 4 of the invention that is prestressed ~~for pressure~~ **in compression**, the booster piston 85 is pressed against the piezoelectric actuator 79, thus subjecting this piezoelectric actuator to compressive prestressing. In the process, the hollow body is braced by its first end 15 against a shoulder 91 of the coupler housing 86. By its second end 17, the hollow body 4 is braced against an adjusting disk 93. Via the adjusting disk 93, the spring force of the hollow body 4 is transmitted to the protrusion 89 of the booster piston 85 and thus to the piezoelectric actuator 79.

Page 12, please replace paragraph [0048] with the following amended paragraph:

[0048] So that the hollow body 4 is concentric with the hydraulic coupler 81 and thus also concentric with the piezoelectric actuator 79, the diameter D_1 of the shoulder 91 is adapted to the inside diameter of the hollow body 4 in such a way that the hollow body 4 is widened slightly when it is slipped onto the shoulder 91. Since the hollow body 4 of the invention has a first seam 31 ~~(not shown)~~ that extends over the entire length of the hollow body, the hollow body 4 can be relatively easily widened far enough that it fits onto the shoulder 91.

Please replace paragraph [0049] with the following amended paragraph:

[0049] If, as in the exemplary embodiment of Fig. 2, the hollow body 4 is acted upon by a compressive prestressing, it suffices if the hollow body can be braced in the axial direction on its ends 17 and 15[[,]] ~~as shown in Fig. 2~~. To further improve the radial fixation of the hollow body 4, an annular groove (not shown) may alternatively or additionally be provided in the shoulder 91 and/or in the adjusting disk 93.

Please replace paragraph [0050] with the following amended paragraph:

[0050] In Fig. 3, a flat sheet 9 is shown, from which a hollow body 4 of the invention can be coiled. Many recesses 7 are punched out of the flat sheet 9. For the sake of simplicity, not all the recesses 7 that have a bonelike shape in the exemplary embodiment shown in Fig. 3 have been identified by reference numerals. The flat sheet 9 is rectangular, and two opposed edges 11 and 13 of the flat sheet 9 may be interrupted by the recesses 7, while the diametrically opposed **ends or** edges 15 and 17 have a straight course and are not interrupted by the recesses 7.

Please replace paragraph [0051] with the following amended paragraph:

[0051] The flat sheet 9 is coiled up into a cylindrical or polygonal hollow body in such a way that the edges 15 and 17 form the first end 15 and second end 17 of the hollow body 4 (see Fig. 4). That is, the longitudinal axis 35, ~~not shown in Figs. 4 and 5,~~ of the hollow body 4 extends parallel to the edges 11 and 13.

Page 13, please replace paragraph [0052] with the following amended paragraph:

[0052] When the flat sheet 9 [[was]] **is** bent as described above into a cylinder or polygon, the edges 11 and 13 touch and form a first seam 31 (see Figs. 4 and 5), which extends parallel to the longitudinal axis 35 of the hollow body 4.

Please replace paragraph [0053] with the following amended paragraph:

[0053] A plurality of recesses 7 are always located one after the other in ~~one row~~ **rows** in the flat sheet 9[[.]] ~~They~~ **and** are separated by webs 19 between the recesses. For the webs 19 as well, no attempt [[was]] **has been** made to identify all the webs of the flat sheet 9 with reference numerals, for the sake of simplicity. When the flat sheet 9 is bent into a hollow body in the way described above, the recesses 7 located one behind the other**, i.e. those located in a row before bending,** are located in [[one]] **a common** plane. For instance, in Fig. 3, one row of recesses 7 that are located one behind the other is indicated by a line 20. In the exemplary embodiment of a flat sheet 9 shown in Fig. 3, 16 rows, each of six recesses 7, are located between the edge 15 and the edge 17.

Please replace paragraph [0054] with the following amended paragraph:

[0054] As seen from Fig. 3, the recesses 7 of [[two]] adjacent rows are offset relative to one another. The offset is selected such that it amounts to half the length of one recess 7 and one web 19. This amount is represented as an example in Fig. 3 by the double arrow 21 for one recess and two half webs 19. This amount is also called the "repeat". The offset between the recesses 7 of two adjacent rows of recesses is designated by reference numeral 23 in Fig. 3.

Page 16, please replace paragraph [0061] with the following amended paragraph:

[0061] According to the invention, a second seam 33 is therefore provided at the edges 15 and 17, at the angle $\phi = 180°$. This second seam 33 will be described below in conjunction with ~~Figs.~~ **Fig.** 5 [[ff]]. The hollow body 4 shown in these figures has been wound from the flat sheet 9 shown in Fig. 1. The edge 17 forms a first end of the hollow body 4, while the edge 15 forms a second end of the hollow body 4.

Please replace paragraph [0062] with the following amended paragraph:

[0062] In Figs. 4 and 5, it can be clearly seen that the edges 11 and 13 of the flat sheet 9 (see Fig. 3) of the hollow body 4 are **in opposed, abutting relation to** ~~diametrically opposite~~ one another. They are not welded together, so that the changes described in conjunction with Fig. 3 (transverse force, bending moment) in the axial direction of the hollow body 4 take place at the first seam 31 formed by the edges 11 and 13.

Please replace paragraph [0063] with the following amended paragraph:

[0063] According to the invention, one or two second seams 33 (see Figs. 5 and 6) are now provided in the hollow body 4, offset from the first seam 31 by 180°. The second seams 33, in the exemplary embodiments of Figs. 5 and 6, are only long enough that they reach one recess 7. As a result, the hollow body 4 is likewise weakened at a circumferential angle ϕ of [[-]] 180°, and the maximum value 27 at circumferential angle ϕ [[=]] **of** 180° is decreased markedly. As a result, this provision means that the spring force exerted by the hollow body 4 on the piezoelectric actuator 1, 79 extends solely in the axial direction. Bending moments or forces in the radial direction are not introduced into the piezoelectric actuator 1, 79.

Please replace paragraph [0064] with the following amended paragraph:

[0064] In Fig. 6, a second exemplary embodiment of a hollow body of the invention is shown. The essential distinction is that an odd number of rows of recesses 7, namely 17 rows, [[is]] **are** provided. The termination of the first seam 31 is therefore the same at the edge 17 and at the edge 15. As a result, the force course is the same at both the edge 15 and the edge 17 and is equivalent to the force course shown in Fig. 3 in conjunction with the edge 17. Since the force course is symmetrical at the two ends 15 and 17 of the hollow body 4, the spring behavior of the hollow body 4 of the invention is further improved. The 17 rows of recesses 7, which are not individually designated by reference numeral in Fig. 6, form 17 planes E_1 through E_{17}, which extend perpendicular to the longitudinal axis of the hollow body 4.

Page 19, please replace paragraph [0070] with the following amended paragraph:

[0070] In Fig. 9, ~~a section through the actuator unit of the invention taken along the line A-A is also shown~~ **the view shown in the upper portion of the figure is located along section A-A of the lower portion**.

Please replace paragraph [0071] with the following amended paragraph:

[0071] In Figs. 10a and 10b, two further versions of hollow bodies 4 of the invention are shown in perspective. In these version, unlike the versions described above, an avoidance of the transverse force of the hollow body on the side diametrically opposite the first seam 31 (where ϕ is approximately equal to 180°) is achieved by providing a recess 51 there. The recess 51 results in a purposeful weakening of the hollow body 4 on the side diametrically

opposite the first seam 31, so that as a result, the hollow body 4 exerts a **force** solely in the axial direction on the piezoelectric actuator 1, 79. The [[sole]] ~~difference~~ **differences** between the versions of Figs. 10a and 10b [[is]] **are** the shape of the recesses 51 **and the location of the recesses 51 relative to the recesses 7**. In the version of Fig. 10a, the recess 51 takes the form of a segment of a circle, while in the version of Fig. 10b the recess 51 is rectangular. The precise definition of the shape of the recesses 51 and of the dimensioning can readily be done for each particular application by one skilled in the art of FEM calculation.

Page 20, please add the following new paragraph after paragraph [0075]:

[0076] The foregoing relates to preferred exemplary embodiments of the invention, it being understood that other variants and embodiments thereof are possible within the spirit and scope of the invention, the latter being defined by the appended claims.